A SUMMARY OF THE ATOPOMELINAE (ACARINA, LISTROPHORIDAE).

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(Nine Text-figures.)

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Synopsis.

The known species of atopomeline fur-mites are listed, and keys are given to the genera and to the species of the large and essentially African genus *Listrophoroides*.

Two new Australian species are described: *Austrochirus perkinsi*, n. sp., from the koala (*Phascolarctos*) and *Atellana papilio*, n. g., n. sp., from the brush-tailed possum (*Trichosurus*).

Campylochirus is shown to contain only the genotype, *C. chelopus*, from *Pseudocheirus* in Tasmania.

***Neolabidocarpus*, from *Macropus* in New Guinea, of which only the holotype nymph appears to be extant, has been reexamined and shown to be an atopomeline and not a labidocarpine genus. Its exact status remains uncertain.**

New combinations: *Listrophoroides adherens* (Trouessart, 1893) and *Chirodiscoides oryzomys* (Radford, 1954).

New synonymy: *Marquesania* Womersley, 1943 = *Listrophoroides* Hirst, 1923; *Listrophoroides trägårdhi* Radford, 1940 = *Marquesania expansa* form *queenslandica* Womersley, 1943 = *Listrophoroides expansus* Ferris, 1932; *Marquesania elongata* Lawrence, 1951 = *Listrophoroides mastomys* Radford, 1940; *Marquesania imbricata* Lawrence, 1954 = *Listrophoroides lemniscomys* Radford, 1940; *Cricetomysia andréi* Lawrence, 1956 = *Campylochirus chelopus* Trouessart, 1893.

A study of the atopomeline fur-mites which have accumulated recently at this Institute has yielded two new species and given supplementary data on certain other Australasian species. This led to an interest in the essentially African genus *Listrophoroides*, and the subsequent receipt of an extensive collection of this genus from Dr. C. D. Radford induced me to add a synopsis of the known genera and species of the subfamily. Twelve genera and 35 species have been included in this group, of which 10 and 29 respectively are here recognized. Species not commented on in the text are readily recognizable from the available descriptions.

This paper is not meant to be a full study of the subfamily, but simply to elucidate the known genera and species, many of which have long been unrecognizable. It is certain that new genera and species remain to be found, and the following generic key is not designed to indicate relationships. For example, I suspect that *Tenrecobia* will prove quite close to *Listrophoroides*.

Key to genera of Atopomelinae.

1. Clasping apparatus enlarged posteriorly, forming a pair of clam-like flaps between coxae II and III. Female with anterior half of body covered dorsally with two shields and posterior half covered by small, pointed papillae. Males with legs IV grossly enlarged, extending far beyond end of abdomen, and as long as entire body; basal movable segment with two stout spines ..... *Atopomelus*.

   Clasping apparatus not so enlarged posteriorly. Body of female, if covered with papillae, with single dorsal shield (*Austrochirus*). Leg IV of male moderately enlarged, and, even if reaching beyond end of abdomen, never more than half as long as body; without spines on basal movable segment ..... 2.

2. Postcapitular shield with narrow transverse frontal lobe arched over the capitulum, producing a hunched facies; clasping apparatus immediately followed by a transverse band of stout retrorse spines ..... *Atellana*.

   Postcapitular shield simple, and set behind the evenly tapering capitulum; no spines behind clasping apparatus ..... 3.

3. With transverse oval shield immediately behind longitudinal postcapitular shield ..... *Tenrecobia*.

   Shields (if any) behind postcapitular shield never transverse oval ..... 4.

4. Postdorsal shield not separated from middorsal shield ..... 5.
Postdorsal shield (if present) widely separated from mid- or anterodorsal shield ..... 7.
5. Abdomen of female with long, thin process arching forward over dorsum; leg IV of male much enlarged and modified, including tarsus ..... *Campylochirus.*
Abdomen of female without long terminal process; leg IV of male only slightly enlarged and with normal tarsus ..... 6.
6. Postdorsal shield of female covering entire hysterosoma (except extreme apex). Male with tarsus IV straight, bearing caruncle apically, and without anal suckers ..... *Listrophoroides.*
Postdorsal shield of female truncate, occupying only anterior half of hysterosoma. Male with tarsus IV hooked, bearing caruncle subapically, and with large anal suckers .... *Chirodiscoides.*
7. With two broad anterior dorsal shields, the hinder one deeply concave anteriorly to accept convex posterior margin of the other; third dorsal shield separated from middorsal shield by broad band of annulated cuticle ..... *Cytostethum.*
With only single dorsal shield anteriorly (which may have lateral accessory lobes); male sometimes with a postdorsal shield, which is widely separated from anterodorsal shield ..... 8.
8. With compact, well developed striate clasping apparatus between coxae I and II. Male genitalia between or behind coxae IV ..... *Austrochirus.*
Described as having coxae I and II widely separated medially, and lacking a striate clasping apparatus; male genitalia between coxae III ..... *Centetesia.*

Austrochirus Womersley.

Austrochirus queenslandicus Womersley, 1943 (genotype).

The type series of this species is recorded and labelled as from the phalangerid *Trichosurus vulpecula* (Kerr), and I had considered the two unnamed species from this host and from bandicoots listed in the Annual Report on the Health and Medical Services of the State of Queensland for the year 1937-38 to be the same. Subsequent collections, however, have shown that *A. queenslandicus* occurs only on the bandicoots *Thylacis obesulus* (Shaw and Nodder) and *Perameles nasuta* Geoffroy, and have yielded a new genus and species described below from *Trichosurus*. It seems certain that mislabelling has occurred, and that the type host of *A. queenslandicus* should be *T. obesulus*, not the phalangerid.

Austrochirus enoplus Domrow, 1956.

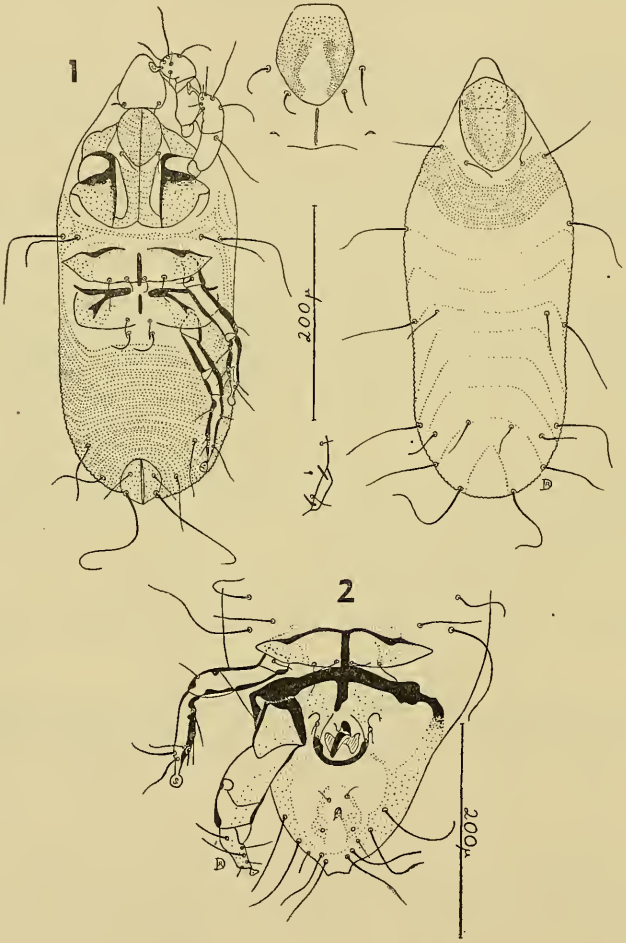
The holotype female and allotype male of this species are now in the Queensland Museum, Brisbane.

Austrochirus perkinsi, n. sp.

Types: Holotype female and allotype male in Queensland Museum, Brisbane; paratypes of both sexes in U.S.N.M. and B.M. (N.H.). All specimens from the koala, *Phascolarctos cinereus* (Goldfuss), Lone Pine Sanctuary, Brisbane, 26.ix.1955, F. A. Perkins coll.

Female.—Dorsum with single, small anterior (postcapitular) shield, which is rather longer than wide, and with a distinct row of heavy punctae on either side. Four setae, of which the external pair is longer, flank this shield. Remainder of dorsum covered with closely annulated cuticle, the contours being as shown; without any medial pattern as in *A. enoplus*. Dorsal setae as follows: two small setae middorsally, a transverse row of four similar setae further back, and five pairs of longer marginal setae, the anterior pair of which is set above the two pairs of setae in front of coxae III. Length of body 425–444μ. *Venter*: Capitulum with usual pair of setae in posterolateral corners. Inner surface of coxae I and II hollowed and striate; with single pair of setae between coxae I and II. With two pairs of longer setae above coxae III. Apodemes of coxae IV stronger than those of III, and both pairs separated by a short median longitudinal sclerotization. Four setae in a line between coxae III, and four in a square between coxae IV. Anus longitudinal and subterminal, with one shorter anterior and one longer posterior pair of adanal setae. Ventral cuticle similar to dorsal, with two pairs of setae posteriorly. *Legs*: Tarsi I and II with caruncles and usual recurved seta dorsally. Apart from the tarsi, the only movable segments of legs III and IV with setae are the basal and penultimate segments of leg III. Tarsi III and IV with setal pattern similar to other species of genus.

Male.—Dorsum and anterior half of venter as in female. Length of body 438–467μ. Apodemes of legs III and IV T-shaped, those of IV being much the stronger. Genitalia behind coxae IV, set in sclerotized ring with two lateral setae. Intromittent organ well sclerotized, quite short and projecting backwardly. Anus flanked by two sclerotized areas, each with a short seta anteriorly and minute sucker posteriorly. Apex of abdomen slightly indented and flanked by five pairs of setae, the central pair being very short. Legs III as in female. Leg IV swollen, with setae on tarsus as shown. Caruncle IV much smaller than III.



Text-fig. 1.—*Austrochirus perkinsi*, n. sp. Left, venter of female. Right, dorsum of female. Inset above, dorsal shield of *A. queenslandicus* Womersley. Inset below, anus of female *A. enoplus* Domrow in lateral view.

Text-fig. 2.—*Austrochirus perkinsi*, n. sp. Venter of male.

Remarks.—Mr. P. J. O'Sullivan recorded a severe outbreak of mange due to *Notoedres cati* (Hering) in the same sanctuary (Minutes of the Entomological Society of Queensland for December, 1949), but *A. perkinsi* is the first native mite to be recorded from the koala. The new species is closely related to *A. queenslandicus* Womersley, both possessing a simple dorsal shield and annulated cuticle. They may be separated on the shape and pattern of punctae on the dorsal shield, the sclerotization of coxae III and IV, and the genitalia and posterior legs of the male. The other two

species of the genus, *A. sminthopsis* Womersley and *A. enoplus* Domrow, have lateral accessory lobes to the dorsal shield and modified cuticular patterns, especially in the former.

Campylochirus Trouessart.

Campylochirus chelopus Trouessart, 1893 (genotype).

I have already (1956) redescribed this species, but Dr. R. F. Lawrence, who is at present engaged on groups other than the Listrophoridae, has asked me to clarify the position regarding one of his species. Among some listrophorid material sent to him from the Trouessart collection in the Muséum National d'Histoire Naturelle in Paris were specimens labelled as from an African rodent, *Cricetomys gambianus* (Waterhouse), which he described (Lawrence, 1956) as a new monotypic genus and species, *Cricetomysia andréi*.

After this paper was published, he received a separate of my redescription (1956) of the genotype of *Campylochirus* from the Tasmanian phalangerid, *Pseudocheirus convolutor* (Oken), and began to suspect that the two species were at least congeneric. Since then we have exchanged specimens, and these have proved to be conspecific. There is no doubt that the syntypes of *Cricetomysia andréi* are also the syntypes from which Trouessart made his original description of *Campylochirus chelopus* in 1893, but how the labels became mixed is conjectural. *Cricetomysia andréi* Lawr. is thus an objective synonym of *Campylochirus chelopus* Trt.

Three other specific names have been traditionally associated with this genus (Radford, 1950), and may be conveniently considered here. Through the courtesy of Dr. Marc André, I have been able to examine the syntypes of *Campylochirus adherens* Trouessart, and these have proved to belong to the African genus *Listrophoroides* Hirst. As the species is unrecognizable from the published data, it is redescribed below.

Ewing (1929) synonymized *Chirodiscoides* Hirst (monotypic for *C. caviae* Hirst) with *Campylochirus* without stating any reasons. It is now clear that his assumptions were wrong, and that he had not seen authentic material of the genotype of *Campylochirus*. The two species here included in *Chirodiscoides* are distinct, and possibly closer to *Listrophoroides* than *Campylochirus*.

The third name to be considered is *Campylochirus latus*, ascribed to Trouessart (without date) by Radford. As a result of correspondence with Dr. Radford and a search through the literature, this name may now be placed as a *nomen nudum*. *Campylochirus* thus contains only the genotype, *C. chelopus* Trt.

Atellana, n. g.

Diagnosis.—Atopomelinae with three dorsal shields (somewhat reduced in female); postcapitular shield anteriorly with narrow, transverse frontal lobe. Coxae II and III closely approximated, with numerous heavy retrorse spines at posterior margin of clasping apparatus. Leg IV of male enlarged, with modified caruncle. Anal suckers present in male. Nymph with postcapitular shield only; otherwise similar to female. With two attenuate tracheal tubes in all stages. Genotype: *A. papilio*, n. sp.

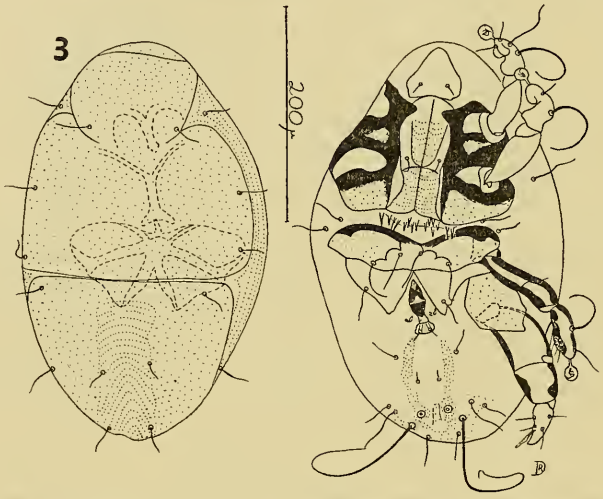
The new genus may readily be separated from all known atopomeline genera by its characteristic dorsal shields (particularly the frontal lobe) and the spines behind the clasping apparatus.

Atellana papilio, n. sp.

Types: Holotype male, allotype female and morphotype nymph in Queensland Museum, Brisbane; paratype male in B.M. (N.H.). All specimens from fur on the thighs and rump of the phalangerid *Trichosurus vulpecula* (Kerr), D'Aguilar Range, S.E. Queensland, 1.iv.1957.

Male.—Dorsum: A frontal lobe, which appears narrow in dorsal view but more extensive laterally, precedes the anterodorsal (postcapitular) shield, and masks the capitulum, producing a characteristic hunched facies. Anterodorsal shield surrounded by four setae, one pair of which is in the longitudinally striated marginal cuticle, and the other in the posterolateral corners of the shield. Middorsal shield broad and

with two pairs of posterolateral setae. Postdorsal shield almost entirely divided medially by band of transverse striations; with eight setae arranged 2.4.2. Length of body 378–388μ. *Venter*: Capitulum almost covered by frontal lobe of anterodorsal shield, but of similar structure to *A. perkinsi* above, as are the structure of legs I and II and the clasping apparatus. Immediately behind coxae II a transverse row of several strong retrorse spines. Two setae above coxae III and a further seta above these. Internal apodemes of coxae III and IV very strongly sclerotized, in form of a butterfly. With four setae in arc between coxae III and two on the triangular lobes between coxae IV and genitalia, which have two minute setae posteriorly. Four setae between genitalia and anus, which is flanked by two small suckers. Apex of abdomen irregularly sclerotized, with four pairs of setae, of which one is very much stronger than the other three. Leg III as in female, with short seta on penultimate segment. Leg IV swollen, with caruncle weak and slender compared with that of tarsus III.



Text-fig. 3.—*Atellana papilio*, n. g., n. sp. Left, dorsum of male. Right, venter of male.

Female.—Frontal lobe and anterodorsal shield as in male. Length of body 448μ. Mid- and postdorsal shields reduced, and without setation. Laterally with longitudinal, and postdorsally with transverse annulations; setation as shown. Anus terminal, with two internal sclerotizations and two pairs of adanal setae. Capitulum and legs I and II as in male. Legs III and IV similar in size. Ventral surface not clearly visible, but probably with four setae between coxae III and two between coxae IV.

Nymph.—Dorsally only with frontal lobe and anterodorsal shield flanked by four setae. Otherwise generally as in female adult. Body length 420μ. The nymph illustrated is somewhat distended, being ready to moult, and containing a full-grown but weakly sclerotized male.

Cytostethum Domrow.

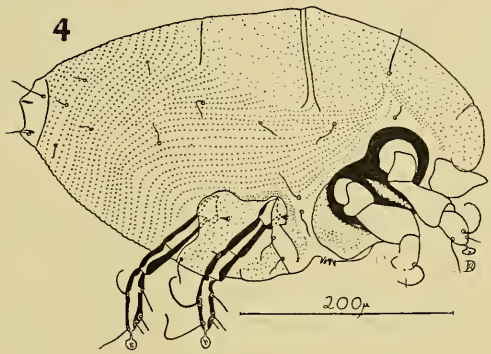
The holotypes of the five species of this genus which I described in these Proceedings in 1956 have been transferred from this Institute to the collection of the Queensland Museum, Brisbane.

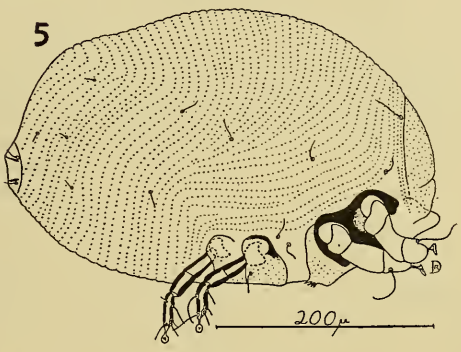
Neolabidocarpus Gunther.

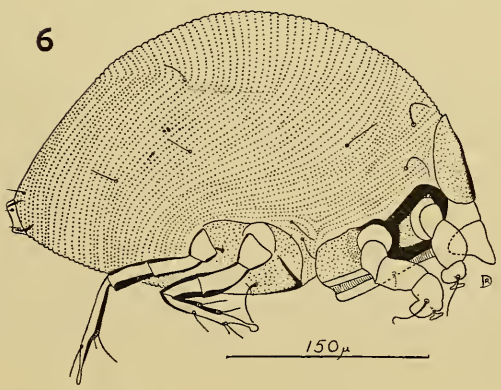
Neolabidocarpus buloloensis (Gunther, 1940).

Gunther recorded placing the "type specimen" of *Labidocarpus buloloensis* in the School of Public Health and Tropical Medicine, Sydney, and later erected a new monotypic genus (*Neolabidocarpus*) for this species, at the same time dividing the Listrophoridae into four subfamilies, *Neolabidocarpus* being placed in the Labidocarpinae.

Through the courtesy of Mr. D. J. Lee, I have been able to examine the sole specimen of this species (from *Thylogale coxenii* Gray, Gunther det.) in the S.P.H.T.M. It is not labelled as type, but certainly belongs to Gunther's species. This specimen is a late nymph and is figured and described below. It is a typical member not of of the Labidocarpinae, but of the Atopomelinae, legs I and II not being greatly







Text-fig. 4.—*Atellana papilio*, n. g., n. sp. Lateral view of female.

Text-fig. 5.—*Atellana papilio*, n. g., n. sp. Lateral view of preadult nymph, slightly distended, enclosing an adult male.

Text-fig. 6.—*Neolabidocarpus buloloensis* (Gunther). Lateral view of holotype nymph.

flattened, and possessing definite caruncles. The coxal apparatus, as shown in Gunther's figures, is also typical of the Atopomelinae. Since the holotype is a nymph, and the remainder of the material was destroyed during the war (Gunther, *in litt.*), it appears best to keep this genus and species apart until fresh adult material proves them valid or otherwise.

Redescription of holotype nymph.—With single anterodorsal shield flanked by two pairs of setae. Remainder of dorsum covered by striations with contours and setation as shown. Anus terminal, with two internal sclerotized bars and two pairs of adanal setae (this type of anus is also present in the female of *Austrochirus enoplus*, see inset). Capitulum and legs I and II typical, with recurved seta dorsally on tarsi I and II. Clasping organ not clear in detail, but typical of Atopomelinae; probably with pair of setae between coxae I and II. With pair of setae above coxae III and a further seta above these. Coxae III and IV also not clear, but of general atopomeline facies. Legs III and IV with usual four movable segments, the setal pattern of the (foreshortened) tarsi being typical of other atopomeline genera. Body length 370μ.

Listrophoroides Hirst.

Diagnosis.—Atopomelinae with three dorsal shields which cover entire dorsum, apart from apex of hysterosoma. Anterior dorsal (postcapitular) shield longer than broad, flanked by two small setae and lateral sclerotized zones which serve for the attachment of legs I and II. Middorsal shield subquadrate, with four setae along anterior margin. Postdorsal shield longer than broad, always with seta in each anterior corner and two pairs of setae on disc of shield, though additional setae may sometimes be present marginally. Capitulum with two basoventral setae. Legs I and II incrassate, with one strong seta dorsally on fused apical segments, and provided with caruncles. Clasping organ between coxae I and II always with two transversely striate areas, between which are a pair of setae. Two attenuate tracheal tubes present. Genitalia of female between coxae III and preceded by a sclerotized arc; with two pairs of anterior setae, two pairs of suckers and one pair of posterior setae. Coxae III with three setae. Legs III and IV not enlarged; with four movable segments. Penultimate segment of leg III with small dorsal seta. Dorsobasal seta on tarsus IV weak. Male genitalia between coxae III and IV; with one pair of anterior setae, two pairs of suckers and two pairs of posterior setae. Penis usually short, but exceedingly long in *L. mastomys*. Coxae III with three setae. Anus without suckers, but flanked by two setae. Posterior body lobe variable, but typically with three pairs of stalked setae, of which the median pair is the strongest. Leg IV somewhat enlarged, with dorsobasal seta of tarsus very strong and elongate. Tarsi IV also with two inner apical sclerotized points and terminal caruncle. Genotype: *L. aethiopicus* Hirst by monotypy.

The genotype has recently been redescribed and refigured (Lawrence, 1956), thus putting this genus on a firm basis. A second species, *L. expansus*, was described by Ferris (1932), who stressed the form of the anterior legs and the lack of spurs on coxae III. However, the former character is only of specific value, and the spurs described by Hirst for the genotype are artefacts (Lawrence, *loc. cit.*). Thus *Marquesania* Womersley, 1943, monotypic for Ferris's species, becomes a synonym of *Listrophoroides*.

Apart from *L. oryzomys*, an American species which has been transferred to *Chirodiscoides* below, there are now fifteen names referable to this genus. A close study of these species has revealed a rather tangled situation, hence the full diagnosis above. Eleven species (nine African, one Ceylonese and one semi-cosmopolitan) are here recognized as valid.

Key to species of Listrophoroides.

1. Body very broad, terminating in two or four exceedingly long setae; postdorsal shield reduced in female. On Bathyergidae ..... 2.
   Body quite slender, never terminating in long flagellate setae; postdorsal shield not reduced in female. On Muridae (except *L. adherens*) ..... 3.
2. Female with apex of hysterosoma lacking pronounced conical process; postdorsal shield evenly sclerotized. Posterior body lobe of male with three pairs of stalked setae, the median pair being very strong ..... *bathyergians*.
   Female with apex of hysterosoma with large conical process; postdorsal shield with two heavily sclerotized areas laterally. Apex of abdomen of male with subquadrate shield bearing a flagellate seta in each posterior corner ..... *zumpti*.

3. Dorsl shields with very regular pattern of scales like those of fish or snakes; penis very long ..... *mastomys.*
   Dorsal shields with another texture; penis very short ..... 4.
4. Dorsal shields heavily sclerotized and roughly pitted to produce a sponge-like effect; venter of hysterosoma of female entirely covered by coarse, pointed papillae .. *africanus.*
   Cuticle of dorsal shields otherwise; venter of hysterosoma normally striate and typically without papillae ..... 5.
5. Dorsal shields with distinct linear striations ..... 6.
   Dorsal shields without linear striations ..... 9.
6. Striations of dorsal shields irregular, and not evenly spaced and transverse; middorsal shield broader posteriorly than anteriorly ..... 7.
   Striations of dorsal shields evenly spaced and transverse; middorsal shield narrower posteriorly than anteriorly ..... 8.
7. Postcapitular shield flanked by two pairs of strong setae; body setae strong; venter of hysterosoma of female without tubercles; coxae III of male simple; posterior body lobe weakly defined ..... *adherens.*
   Postcapitular shield flanked by two pairs of very weak setae; body setae weak; venter of hysterosoma of female with several drop-shaped tubercles posteromedially; coxae III of male produced inwardly to form two sclerotized processes; posterior body lobe strongly sclerotized and well defined ..... *lemniscomys.*
8. Striae on dorsal shields very distinct; discrete and crescentic anteriorly and laterally, but transverse medially and posteriorly; striations of clasping organ not reaching lateral edges of coxae I and II ..... *leggadilla.*
   Striae on dorsal shields weaker (sometimes lacking on middorsal shield), and evenly transverse; striations of clasping organ reaching extreme lateral margins of coxae I and II ..... *expansus.*
9. Lateral margins of hysterosoma serrate; female with posterior margin of middorsal shield even, and venter and dorsal apex of hysterosoma non-striate; male with expanded posterior body lobe with four short and two long stalked setae ..... *aethiopicus.*
   Lateral margins of hysterosoma smooth; female with posterior margin of middorsal shield armed with stout median spine; venter of hysterosoma with longitudinal striae, and apex dorsally with transverse striae; male with posterior body lobe not expanded and with about four long setae ..... *womersleyi.*

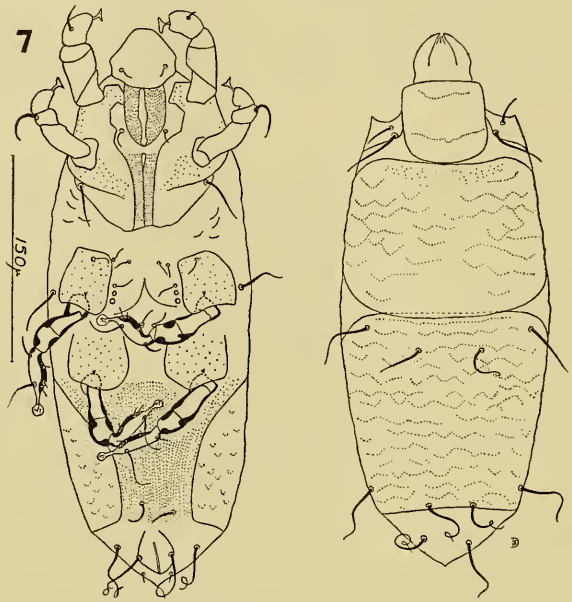
LISTROPHOROIDES ADHERENS (Trouessart, 1893), n. comb.

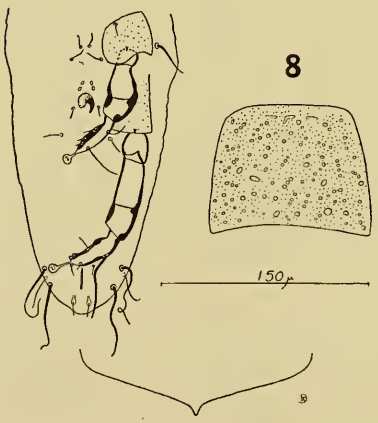
Description of female.—A slender, well-sclerotized species; body length 378–392μ. Anterodorsal (postcapitular) shield slightly longer than broad, flanked laterally by two pairs of setae above insertions of legs I. Middorsal shield subquadrate, with irregular scale-like markings and without setae. Postdorsal shield longer than wide, with rather more distinct scale-like markings, and an anterior and posterior transverse row of four slender setae. Apex of hysterosoma triangular, with minute apical point; not covered by postdorsal shield, but with two slender setae. *Venter*: Capitulum with two basal setae. Genitalia placed between coxae III, with usual three pairs of small setae and two pairs of minute suckers. Posteroventral margins of hysterosoma covered by lateral lobes of postdorsal shield. Medially with fine longitudinal striae, but without tubercles; with two seta posteriorly. Anus longitudinal and subterminal, flanked by three pairs of slender setae, the posterior pair being much the shortest. A tracheal system similar to that of *L. expansus* figured below is present. *Legs*: Legs I and II typical of subfamily. Inner surfaces of coxae I and II hollowed and striate, with a pair of small setae between the two striate zones. Coxae II with stronger seta on posteroventral margin (this seta probably represents the outer pair of the six seta normally present flanking the postcapitular shield and along the anterior margin of the middorsal shield). Coxae III with single anterior seta and flanked by a larger and a smaller seta. Coxae IV without setae. Legs III and IV with usual four movable segments; penultimate segment of leg III apparently without dorsal seta.

Description of male.—As in female dorsally and anteriorly, but somewhat smaller; length of body 350–360μ. Genitalia set between coxae IV, with usual three pairs of small setae and two pairs of minute suckers. Anus longitudinal and subterminal, with pair of small adanal setae anteriorly. Posterior body lobe simple, with extremely shallow posteromedian lobe; with two pairs of long slender ventrolateral setae and one pair of small terminal setae; also with two setae arising dorsally, being the outer pair of the posterior row of four setae on postdorsal shield. Legs III (including coxae)

as in female. Legs IV somewhat enlarged, with dorsobasal seta of tarsus very strong and much elongated. Tarsus IV with two minute ventroapical spurs. Caruncle terminal.

Remarks.—Trouessart (1893) placed this African species in the genus *Campylochirus*, but it is unrecognizable from the available descriptions. (The specific name was spelt *adhaerens* by Trouessart in 1917, but this is regarded as an erroneous





Text-fig. 7.—*Listrophoroides adherens* (Trouessart). Left, venter of female. Right, dorsum of female.

Text-fig. 8.—*Listrophoroides adherens* (Trouessart). Venter of male. Inset at right, middorsal shield of *Listrophoroides africanus* Radford; below, outline of posterior margin of middorsal shield of female of *Listrophoroides womersleyi* (Lawrence).

subsequent spelling.) Through the courtesy of Dr. Marc André I have been able to reexamine Trouessart's ten syntypes from *Anomalurus fraseri erythronotus* Milne Edwards from the Congo, Dybowsky coll. The specimens have been remounted successfully on two slides which have been returned to the Muséum National d'Histoire Naturelle in Paris. One slide (with the original labels) contains the lectoholotype

female and the lectoallotype male, and the other six paratype females and two paratype males. The species is a typical member of the genus *Listrophoroides*, and may be separated from the other species of the genus by the above key. Lawrence (1956) did not include it in his revision of *Listrophoroides*, although he had examined the material.

LISTROPHOROIDES AETHIOPICUS Hirst, 1923.

This species has been discussed above, but it should be noted that in Hirst's figure the third (posterior) pair of genital suckers are artefacts, and that the second pair of postgenital setae are not depicted. In Lawrence's figure (1956) the adanal setae are lacking. I attach no significance to the minor variation in the posterior body lobe and dorsobasal seta of tarsus IV in the male.

LISTROPHOROIDES AFRICANUS Radford, 1944 (emend.).

This species was described from the same host and locality as *L. mastomys* Radford. The slide I have examined is labelled as containing three female *L. mastomys*, but really contains one female *L. mastomys* and a pair of *L. africanus*. Ventrally the male may be recognized by the strongly sclerotized, fused coxal plates of legs III and IV, which are extended inwardly, though not meeting medially, behind coxae IV to flank the genitalia posteriorly. The clasping apparatus is striate. The most striking character of this species is, however, the texture of the dorsal shields. These are heavily sclerotized, and with typical fine punctae. However, this punctation is overlaid by very numerous, much larger and deeper pits of variable size and shape, which are evenly spread over the entire surface, producing a rough, areolate and almost sponge-like appearance. The female is in lateral view and freshly moulted, but has similar dorsal shields to the male. The venter of the hysterosoma is entirely covered with strong, outstanding tuberculate processes. Lawrence (1956) in his key says that in *L. mastomys* the female has the "ventral surface roughened with large sharp granules", and probably examined this same slide. However, he has associated the sexes wrongly, since in the female in question the dorsal shields have the same characteristic texture as the male of *L. africanus*. As the name of the genus is of masculine gender, the termination of the specific name has been amended.

LISTROPHOROIDES BATHYERGIANS Radford, 1939.

This characteristic species and *L. zumpti* form a distinct group found only on bathyergid rodents, the other species being typically from Muridae. These two species may be recognized by their broad bodies and the possession of long terminal flagellate setae. Lawrence (1956) says that both lack striae on the clasping apparatus between coxae I and II, but this is incorrect. Under oil immersion, typical striae are present both in Radford's types and in specimens of *L. zumpti* with collection data as in the type series. This character appears to be constant throughout the subfamily, but should be checked in *Centetesia* Lawrence.

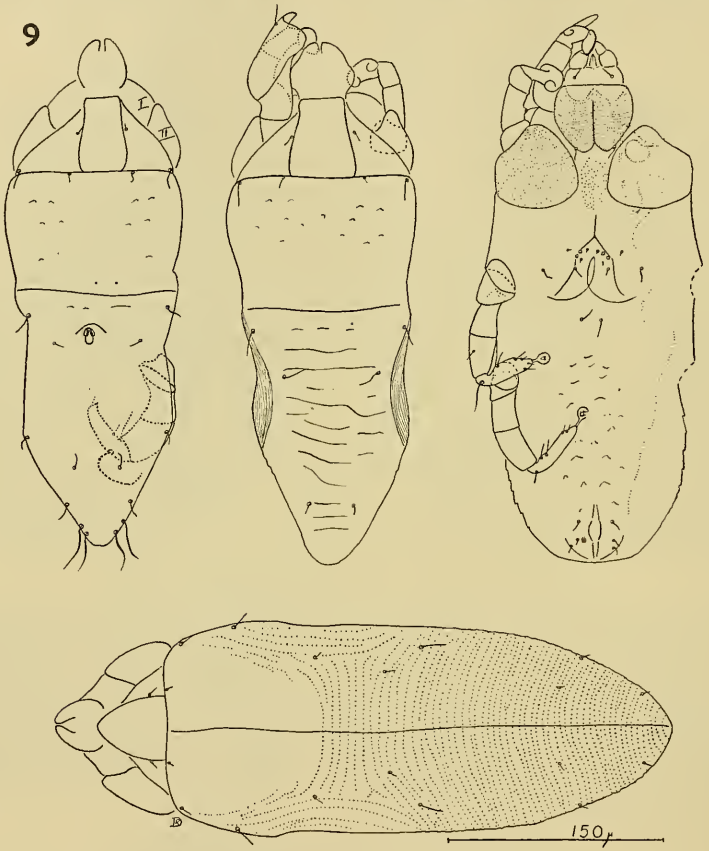
LISTROPHOROIDES DASYMYS Radford, 1942.

This species, which certainly belongs to *Listrophoroides*, is known only from a single male. As the description contains no detail of value in determining its specific status, and the figure is semidiagrammatic and inaccurate, I have left this form as a *species inquirenda*. It will undoubtedly prove to have striae between coxae I and II, two pairs of small genital suckers, and 4-segmented legs III and IV. The description calls for a long seta on leg II, but in the figure it is leg I that has a long seta. The dorsal surface is not described.

LISTROPHOROIDES EXPANSUS Ferris, 1932.

Synonymy.—Womersley (1943) described and figured *Marquesania expansa* form *queenslandica* from rats from S.E. Queensland on the basis of the lack of striations on coxae I and II, and the absence of a "tooth" on leg I. However, he was mistaken on both points, and the form is here regarded as a synonym of Ferris's species. Coxae I and II in all stages are obviously striate as illustrated. An oval, punctate sternal area is always present between the striations of coxae II. The "tooth" on

leg I requires further explanation. In dorsal and particularly in ventral view, leg I appears to have a sclerotized process, but this is due to observing a narrow hyaline lobe from end to end. In dorsolateral view the hollowed inner surface of this lobe may be seen to clasp the shaft of the hair of the host, the free segments of legs I and II passing right around the hair. The mode of attachment is similar to that figured by Lawrence (1954) for *Tenrecobia pauliani* (the original spelling "*pauliana*" is in contravention of Article 14, and thus subject to automatic correction) from Madagascar. Some other details of Womersley's description also need correction. The anterior dorsal (postcapitular) shield is not broadly transverse, but decidedly longi-



Text-fig. 9.—*Listrophoroides expansus* Ferris. Left, dorsum of male preadult nymph. Centre, dorsum of female preadult nymph. Right, venter of female preadult nymph. Below, dorsum of penultimate nymphal stage showing suture line.

tudinal, with distinct lateral margins and setae arranged as figured for the nymph. The areas to the side of this shield serve for the attachment of legs I and II. The inverted Y containing the genitalia of the adult male is heavily sclerotized cuticle rather than a definite structure.

A second synonym of this species is *Listrophoroides trägårdhi* Radford, 1940, the striking similarity between the published descriptions being confirmed by the study of specimens kindly lent to me by Dr. Radford. Of the available figures, those of Ferris are the best.

Distribution.—This species is apparently almost cosmopolitan on *Rattus rattus* (Linné) and *R. norvegicus* (Berkenhout), and has probably spread onto native rodents from these two species. It has been recorded from Sierra Leone, Uganda, Ceylon

and the Maldive and Marquesas Is. It is also common on *R. assimilis* (Gould) in S.E. Queensland, and may now be recorded from North Queensland as follows: *R. rattus*, Sundown, 23.viii.1956, and Innisfail, 9.x.1956, and *R. assimilis*, Bartle Frere, 13.ii.1957. Recent material from *R. gestroi gestroi* (Thomas), Porebada Village, Port Moresby, Papua, 19.xi.1956, comprises preadult nymphs of both sexes. Each nymph is still enclosed in the skin of the penultimate nymphal stage, which shows a distinct central longitudinal suture from the anterior edge of the middorsal shield to the apex of the hysterosoma, which may be still intact or gaping widely. In one specimen the final nymph came out of its old skin during mounting procedure. Womersley only described the adults, and although the present nymphs are quite pale, they are adequate for illustration and are described below.

Description of preadult male nymph.—Length 350–362μ. Anterodorsal (postcapitular) shield longitudinal, slightly wider posteriorly, and flanked by two small setae. Suture between postcapitular and middorsal shield well marked, with four setae arranged along it. Middorsal shield subquadrate, with few scale-like markings. Third (postdorsal) shield covering remainder of dorsum, with about eight setae as figured. Apex of hysterosoma without well-developed accessory lobe of adult, but with six fairly strong setae. *Venter*: Genitalia small and poorly developed, situated between coxae III and IV, and without any inverted Y sclerotization. Legs as in preadult female nymph, but leg IV slightly thicker.

Description of preadult female nymph.—Length 374–385μ. The structure of the anterior two pairs of legs is described above. Anterior half of body as in preadult male nymph. Postdorsal shield constricted medially, with transverse markings, and flanked by lateral cuticular areas with longitudinal striations; with six setae. *Venter*: Two zones of striae between coxae I and II, the former with small seta near inner posterior margin, and latter extending to extreme lateral margins of body. Radford's interpretation of these normal striae as a "toothed semicircular process" is incorrect. Oval, punctate sternal area between coxae II. Genitalia between coxae III, with setae and minute suckers arranged about an inverted Y. Anus subterminal, flanked by about six small setae. Legs III and IV not greatly enlarged. With distinct tracheal system on either side, consisting of a spherical atrium between coxae I and II opening into a single trachea, which becomes thicker along its course, and thins again posteriorly. A similar tracheal system was illustrated by Hirst (1921) for *Listrophoroides aethiopicus*.

Description of penultimate nymphal stage.—Length in distended condition 409–432μ. Similar to preadult female nymph anteriorly and ventrally. Dorsum with postcapitular shield and weakly defined middorsal shield. Remainder of body covered with striations which are longitudinal midlaterally and transverse posteriorly. With central suture-line along dorsum, through which the preadult nymph emerges. Legs III and IV slightly thinner than figured for preadult nymphs. The earlier, rather similar nymphal stage with six legs described by Ferris has also been seen.

Listrophoroides leggadilla Radford, 1947.

This form was originally described as a full species from Ceylon, but may prove to be a variant of the cosmopolitan *L. expansus*. Both forms are of identical facies and setation, particularly as regards the shape of the dorsal shields and their texture, and the posterior body lobe and the form and setation of the legs in the male. The postdorsal shield is narrower than shown by Radford, and the ventrolateral hysterosomal shields, if present, very weakly defined and with margins indiscernible. The transverse markings on the dorsal shields are much more distinct than in *L. expansus*, but are not crescentic as depicted by Radford, except laterally and anteriorly. The discal markings, especially posteriorly, are transverse and evenly spaced as in *L. expansus*. The Y-shaped sclerotization around the male genitalia is not well defined, and the striae on the clasping apparatus do not reach the extreme lateral margin of the coxae as in *L. expansus*, but finish evenly, well in from the edge of the coxae, along a longitudinal line as figured by Radford.

Listrophoroides lemniscomys Radford, 1940.

Both this species and *Marquesania imbricata* Lawrence, 1954, were described from *Lemniscomys* in Uganda and Zululand respectively. Comparison of both sexes of Lawrence's species from the type series and of Radford's from the type host has revealed complete identity in cuticular pattern and fine detail, including the two characteristic crescentic marks at the anterior edge of the middorsal shield, the large bases to the gnathosomal setae, the posteromedian ventral tubercles of the female and the posterior body lobe of the male. *M. imbricata* is therefore considered a synonym of *L. lemniscomys*.

Listrophoroides mastomys Radford, 1940.

This species may be readily recognized by its evenly scaled cuticle, which is a reminiscent of snake or fish skin. Some rather strong longitudinal lines are present laterally on the middorsal shield. Specimens of both sexes from the type series of this species agree in cuticular pattern and in all fine detail with the full description of *Marquesania elongata* Lawrence, 1951, and possess in the male both the characteristic posterior body lobe and the ventrolateral, inwardly directed points behind coxae IV. Lawrence (1951, 1956) is in error in saying coxal striae are absent. The enormously long penis is characteristic of the species, but apparently could not be seen by Lawrence, whose only specimen was obscured by a hair. The two species are here considered identical. The females referred to this species in Lawrence's key (1956) are really *L. africanus* (*q.v.*), which was originally collected from the same host and locality.

Listrophoroides womersleyi (Lawrence, 1951).

This species may be immediately recognized by the characteristic pattern of cuticular striae at the apex of the hysterosoma of the female, and (at least in the female) by a distinct pointed median process (not shown in Lawrence's figure) on the posterior margin of the middorsal shield. Two nymphs examined show a longitudinal middorsal suture and dorsal shields similar to those figured above for *L. expansus*.

Listrophoroides zumpti Lawrence, 1956.

This species has been discussed under *L. bathyergians*.

Chirodiscoides Hirst.

This genus is monotypic for *C. caviae* Hirst, 1917, the widespread parasite of guinea-pigs, which originally came from South America. The species is well illustrated in Hirst (1922) and Lawrence (1956).

Chirodiscoides oryzomys (Radford, 1954), n. comb.

This American species was originally described as a *Listrophoroides*, but has the following important generic characters in common with *C. caviae*: Males with four setae between coxae III and IV; genitalia flanked posteriorly by two setae and four minute suckers; anus surrounded by two setae and two large suckers; posterior body lobe well developed; leg III normal; leg IV enlarged; tarsus IV hooked distally, with two inner apical sclerotized points and subapical external caruncle. Both sexes with three dorsal shields, the middorsal being rather narrow. Females with postdorsal shield truncate, leaving posterior half of hysterosoma covered only by annulated cuticle. Radford's species has therefore been reassigned as a second species of *Chirodiscoides*. Since his figure is incorrect in several details, the following supplementary data are given.

Male.—Clasping apparatus striate between coxae II as well as coxae I. Dorsum with three shields as follows: Postcapitular shield deeply convex posteriorly, extending back to level of coxae II; flanked posteriorly by four setae. Middorsal shield very narrow medially, reaching back only to level of posterior edge of basal movable segment of leg II; straight posteriorly and concave anteriorly to accept postcapitular shield. Postdorsal shield covering remainder of hysterosoma and deeply cleft posteriorly. Penis slender and of moderate length, running forward and then turning abruptly backwards. Posterior body lobe with strong median cleft, the inner posterior

angles of the two lateral processes being turned inwardly; with two normal setae ventrally and four stalked setae laterally on each process. With strong, rod-like, transverse coxal apodemes between legs III and IV, that of IV being the thickest; united medially by strong longitudinal strut and enclosing four setae (a rather similar pattern is illustrated for *Austrochirus perkinsi* above). Legs III and IV with

Synopsis of the Subfamily Atopomelinae (Listrophoridae).
(Genotypes listed first, followed by other species in alphabetical order.)

Genera and Species.	Host.	Locality.
ATELLANA, n.g.		
A. papilio, n.sp...	*Trichosurus.*	Queensland.
ATOPOMELUS Trouessart, 1917.		
A. locusta Trouessart, 1917	*Neotetracus.*	China.
AUSTROCHIRUS Womersley, 1943.		
A. queenslandicus Womersley, 1943	*Thylacis.*	Queensland. Occasionally on *Perameles.*
A. enoplus Domrow, 1956	*Hydromys.*	Queensland.
A. perkinsi. n.sp.	*Phascolarctos.*	Queensland.
A. sminthopsis Womersley, 1954	*Sminthopsis.*	South Australia.
CAMPYLOCHIRUS Trouessart, 1893.		
C. chelopus Trouessart, 1893.	*Pseudocheirus.*	Tasmania.
C. latus	——	—— *Nomen nudum.*
CENTETESIA Lawrence, 1954.		
C. tiptoni Lawrence, 1954	*Hemicentetes.*	Madagascar.
C. tessellata Lawrence, 1954	*Hemicentetes.*	Madagascar.
CHIRODISCOIDES Hirst, 1917.		
C. caviae Hirst, 1917	*Cavia.*	Widespread.
C. oryzomys (Radford, 1954)	*Oryzomys.*	U.S.A. New combination.
CRICETOMYSIA Lawrence, 1956.		Synonym of *Campylochirus.*
C. andréi Lawrence, 1956	*Cricetomys* (!).	Africa (!). Synonym of *Campylochirus chelopus.*
CYTOSTETHUM Domrow, 1956.		
C. promeces Domrow, 1956	*Potorous.*	Queensland.
C. charactum Domrow, 1956	*Potorous.*	Queensland.
C. nanophyes Domrow. 1956	*Potorous.*	Queensland. Also Tasmania.
C. pseudocharactum Domrow, 1956	*Potorous.*	Queensland.
C. trachypyx Domrow, 1956	*Potorous.*	Queensland.
LISTROPHOROIDES Hirst, 1923.		
L. aethiopicus Hirst, 1923	*Cricetomys.*	Africa.
L. adherens (Trouessart, 1893)	*Anomalurus.*	Congo. New combination.
L. africanus Radford, 1944	*Maslomys.*	Sierra Leone. emend.
L. bathyergians Radford, 1939	*Bathyergus.*	South Africa.
L. dasymys Radford, 1942	*Dasymys.*	Uganda. *Species inquirenda.*
L. elongatus (Lawrence, 1951)	*Aethomys.*	Natal. Synonym of *L. mastomys.*
L. expansus Ferris, 1932	Muridae.	Widespread.
L. imbricatus (Lawrence, 1954)	*Lemniscomys.*	Zululand. Synonym of *L. lemniscomys.*
L. leggadilla Radford, 1947	*Leggadilla.*	Ceylon.
L. lemniscomys Radford, 1940..	*Lemniscomys.*	Uganda.
L. mastomys Radford, 1940	*Mastomys.*	Sierra Leone.
L. queenslandicus (Womersley, 1943).. ..	*Rattus.*	Queensland. Synonym of *L. expansus.*
L. trägårdhi Radford. 1940	Muridae.	Widespread. Synonym of *L. expansus.*
L. womersleyi (Lawrence, 1951)	*Otomys.*	South Africa.
L. zumpti Lawrence, 1956	*Georychus.*	South Africa.
MARQUESANIA Womersley, 1943.		Synonym of *Listrophoroides.*
NEOLABIDOCARPUS Gunther, 1942.		
N. buloloensis (Gunther, 1940)	*Thylogale.*	New Guinea. *Species inquirenda.*
TENRECOBIA Lawrence, 1954.		
T. pauliani Lawrence, 1954	*Ericulus.*	Madagascar. emend.

usual four movable segments (the long medial segment of leg IV in Radford's figure is weakly divided centrally). Penultimate segment of leg III with small dorsal seta. Tarsus IV hooked distally, with two inner apical sclerotized points as in *Listrophoroides*; caruncle set dorsally and subapically.

Female.—Anterior half of body as in male. Postdorsal shield truncate, extending to midway between level of coxae IV and apex of hysterosoma; quite concave

posteriorly. Apex of hysterosoma simple. Genitalia between coxae III. Legs III and IV of normal size; tarsus III with enlarged dorsobasal seta.

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References.

Domrow, R., 1956*a*.—Notes on Australian fur-mites (Listrophoridae, Atopomelinae), with description of a new genus. Proc. Linn. Soc. N.S.W., 80: 191-200.

————, 1956*b*.—The genera *Campylochirus* Trouessart and *Austrochirus* Womersley in Australia (Acarina, Listrophoridae). Proc. Linn. Soc. N.S.W., 80: 234-239.

Domrow, R., and Smith, D. J. W., 1956.—Acarina from five hundred native mammals from Queensland. Proc. Linn. Soc. N.S.W., 80: 201-206.

Ewing, H. E., 1929.—*A manual of external parasites.* Baillière, Tindall & Cox, London. Page 44.

Ferris, G. F., 1932.—Ectoparasites of Marquesan rats. *Bull. Bishop Mus., Honolulu,* 98: 117-127.

Gunther, C. E. M., 1940.—A listrophorid parasite of the wallaby from New Guinea. Proc. Linn. Soc. N.S.W., 65: 353-354.

————, 1942.—Notes on the Listrophoridae (Acarina, Sarcoptoidea). Proc. Linn. Soc. N.S.W., 67: 109-110.

Hirst, S., 1917.—On three new parasitic Acari. *Ann. Mag. nat. Hist.,* (8) 20: 431-434.

————, 1921.—Notes on parasitic Acari. A. On the presence of a system of tracheal tubes in the families Sarcoptidae and Listrophoridae. *J. Queckett micr. Cl.,* 14: 229-232.

————, 1922.—*Mites injurious to domestic animals.* Brit. Mus. (Nat. Hist.), Economic Series No. 13, 107 pp.

————, 1923.—On some new or little known species of Acari. *Proc. zool. Soc. Lond.,* 971-1000.

Lavoipierre, M., 1946.—New records of Acari from Southern Africa and the Belgian Congo. *J. ent. Soc. S. Afr.,* 9: 78-81.

Lawrence, R. F., 1951.—New fur mites from South African mammals. *Ann. Natal Mus.,* 12: 91-133.

————, 1954*a*.—Two new fur-mites from rodents. *J. ent. Soc. S. Afr.,* 17: 38-46.

————, 1954*b*.—Studies on the listrophorid mites (Sarcoptiformes) of Centetidae from Madagascar. *Mém. Inst. Sci. Madagascar,* 9A: 129-149.

————, 1956.—Studies on South African fur-mites (Trombidiformes and Sarcoptiformes). *Ann. Natal Mus.,* 13: 337-375.

Radford, C. D., 1939.—Notes on some new species of parasitic mites. *Parasitology,* 31: 243-257.

————, 1940.—Notes on some new species of parasitic mites. *Parasitology,* 32: 91-104.

————, 1942.—New parasitic mites (Acarina). *Parasitology,* 34: 295-307.

————, 1944.—New parasitic mites (Acarina) from rodents. *Parasitology,* 35: 161-166.

————, 1947.—Parasitic mites from snakes and rodents (Acarina Cheyletidae, Listrophoridae and Laelaptidae). *Proc. zool. Soc. London.,* 117: 228-240.

————, 1950.—The mites (Acarina) parasitic on mammals, birds and reptiles. *Parasitology,* 40: 366-394.

————, 1954.—Three new species of fur mites (Acarina: Listrophoridae). *Riv. Parassit.,* 15: 593-599.

Trouessart, E. L., 1893.—Note sur les sarcoptides pilicoles (Listrophorinae). *C. R. Soc. Biol., Paris,* (9) 5: 698-700.

————, 1917.—Troisième note sur les sarcoptides pilicoles et description de genres nouveaux. *Bull. Soc. zool. Fr.,* 42: 151-158.

Womersley, H., 1943.—Australian species of Listrophoridae Canest. (Acarina) with notes on the new genera. *Trans. roy. Soc. S. Aust.,* 67: 10-19.

————, 1954.—Two new species of ectoparasitic mites from pouched mice, *Sminthopsis,* from Australia. *Rec. S. Aust. Mus.,* 11: 117-120.